

# **Students are citizen scientists! Engaging your students in local environmental study**

presentation by  
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## *What is Citizen Science?*

**The growing field of public participation in scientific research (PPSR) includes citizen science, volunteer monitoring, and other forms of organized research in which members of the public engage in the process of scientific investigations: asking questions, collecting data, and/or interpreting results on natural phenomena in much the same way as trained scientists.**

Citizen science projects yield new knowledge by providing access to more observations and data than traditional science research. Citizen science often focuses on a question or issue that requires data to be gathered or processed over long periods of time and/or wide geographic areas – more than can be reasonably completed by a handful of scientists working in a particular field of study.

Although projects vary in the degree of collaboration between science researchers and volunteers, many projects provide volunteers with training or tutorials in project procedures to ensure consistency in data collection. Projects may engage a handful of participants in a small watershed or many thousands of observers located across several continents.

Citizen science projects have real goals for science—for example, to document changes in populations of plants or animals or variations in the quality of air or water—and/or goals for learning, for instance, to improve participant understanding of scientific content or capacity for addressing scientific issues. Many projects also have goals for actions based on resulting scientific outcomes. In addition, over 100 articles have been published, in peer-reviewed scientific literature, which analyze and draw significant conclusions from citizen science data. Many articles and book chapters describing learning outcomes for participants also have been published. Numerous publications document action outcomes as well, and offer strategies for linking research findings with management and decision making in different contexts.

Adapted from:

*Citizen Science Central, Cornell Lab of Ornithology,*

<http://www.birds.cornell.edu/citscitoolkit/about/defining-citizen-science/>

## PLANTS AND ANIMALS

### **Celebrate Urban Birds (Cornell Lab of Ornithology)**

<http://celebrateurbanbirds.org/>

Observe and document common birds in urban areas and submit data online through the Cornell Lab. Does not require prior experience with bird watching. Each school can receive a free kit, or individual classroom can purchase kits for \$5.00.

### **Project FeederWatch (Cornell Lab of Ornithology)**

<http://feederwatch.org>

Document types and numbers of bird species from November through April

You can log bird observations with an iPhone app called Birdseye Birdlog for \$10:

<https://itunes.apple.com/us/app/birdseye-birdlog-north-america/id509841114?mt=8&ign-mpt=uo%3D4> or

Merlin Bird ID app for iPhone or Android for **FREE**: <http://merlin.allaboutbirds.org/>

### **Hummingbirds@Home (Audubon Society)**

<http://www.hummingbirdsathome.org/>

The purpose of this project is to document the effects of climate change on the blooming time of flowers that serve as nectar sources for hummingbirds. Students can report on hummingbirds and their feeding behavior at any time of year using the website or a FREE app for Android or iPhone. Students can participate at any level - from reporting a single sighting to documenting hummingbird activity in your community throughout the life of the project.

### **Monarch Larva Monitoring Project**

<http://www.mlmp.org/Default.aspx>

This project was begun at the University of Minnesota to collect long-term data on larval monarch populations and milkweed habitat. The focus of the project is to better understand monarch distribution and abundance during the breeding season in North America. The website has online training for identifying monarch larvae, information about both monarch and milkweed life history. There are also data sheets with images of larval instar stages. Data can be entered on the website.

### **Project Sunflower**

<http://www.greatsunflower.org/>

Observe and record the number and types of **pollinators** that visit plants. You do not have to plant sunflowers in your schoolyard. Students can observe any flowers, record and submit data online. Project is intended to gather broad scale data on pollinators, especially bees, to better understand colony collapse disorder and other environmental factors that affect pollinator populations.

### **What's Invasive!**

<http://www.whatsinvasive.org/index.cfm>

Track invasive plant and animal species using a FREE iPhone or Android app. You can also set up your own school site as independent site for data collection. This project is a collaboration between UCLA's Center for Embedded Network Sensing, the National Park Service, and the Center for Invasive Species and Ecosystem Health at the University of Georgia.

### **Global Garlic Mustard Field Survey**

<http://www.garlicmustard.org/>

Garlic mustard, *Allaria petiolata*, is a noxious weed found in eastern North America, including Maryland. When it is introduced, garlic mustard spreads rapidly in a few growing seasons and chokes out native wildflowers, thus reducing biodiversity. On this website, you can find information on how to identify

garlic mustard, instructions for field sampling, and data collection. This project is great for teaching students basic field sampling techniques with simple tools such as meter sticks and tape measures.

### **Project BudBurst**

<http://budburst.org/>

The purpose of this project is to gather longitudinal data on the phenology (i.e., life history stages) of plants growing in North America to document what changes in plant bloom time, leaf out and leaf drop are occurring due to climate change. Document the phenophases (i.e., leaf out, leaf drop, flowering and fruiting phases) of native and non-native plants. The website provides implementation guides by grade bands (elementary, middle, secondary), a tutorial on observing plants, and data forms for recording data. Data can be entered on the website or through an online app compatible with Mac or Android devices but requires Internet access.

### **USA National Phenology Network**

<http://www.usanpn.org/home>

The USA-NPN monitors the influence of climate on the phenology of plants animals and landscapes. Students can participate by documenting phenophases of local plants and animals through Nature's Notebook ([https://www.usanpn.org/natures\\_notebook](https://www.usanpn.org/natures_notebook)), which includes tutorials on how to observe, how on set-up an account and how to download the FREE app for iPhone or Android devices.

### **Project Noah**

<http://www.projectnoah.org/>

This project, supported by the National Geographic Society, aims to document biodiversity through citizen scientists who take pictures of plants, animals, fungi, etc., and document ecological data. From the website, project developers state that they "...are building a powerful force for crowdsourcing ecological data collection and an important educational tool for wildlife awareness and preservation." Data can be entered through the website or a FREE app for Mac and Android devices. You can start your own local "mission" that allows students to focus on a particular organism or group of organisms, or you can join a current mission and add to knowledge that way.

### **FrogWatch**

<http://www.aza.org/frogwatch/>

Frogs and other amphibians are indicators of environmental health. Adding data gives baseline information about population declines and the effects of conservation on (human) health. Website contains monitoring protocols, data sheets and helpful identification info for regional species of frogs, including a link to Maryland DNR's website with frog identification. This project is probably most appropriate for upper middle or secondary students.

### **Project Squirrel**

<http://www.projectsquirrel.org/>

Monitor types and numbers of squirrels and their behavior patterns. This would be especially viable project for lower elementary students. It has a FREE app that can be downloaded on Mac and Android devices.

## **WATER**

### **Creek Watch**

<http://creekwatch.researchlabs.ibm.com/>

This is an iPhone application that enables students to monitor the health of local watersheds. The app collects four pieces of data: (1) amount of water (empty, some, full); (2) rate of flow (still, moving slow, moving fast); (3) amount of trash; (4) a picture of the waterway.

## **World Water Monitoring Challenge**

<http://www.monitorwater.org/default.aspx>

This is an education and outreach program designed to educate citizens in the protection of water resources. Students conduct simple water quality tests and submit data online. The program runs annually from March 22 through December 31. You can order a water quality kit from the website or use your own equipment to measure temperature, pH, turbidity and dissolved oxygen. Students can also write stories and publish photos on the WWMC website. There are fact sheets and student activity handouts posted on the website.

## **WEATHER**

### **Snowtweets**

<http://snowcore.uwaterloo.ca/snowtweets/>

Tweet the depth of snow (or no snow!) to researchers in Canada using your Twitter account using this tweet format:

#snowtweets <depth> at <location>

You can use English or metric units and location data can be a zip code, full address or GPS coordinates. Project aims to collect real time data on snow depth globally.

### **mPING Project**

**Meteorological Phenomena Identification Near the Ground (mPING)** is a project to collect weather information from the public through their smart phone or mobile device – iPhone or Android platforms. Users with the mPING app can select what type of weather is occurring and submit a report. The user's location and the time of the observation are automatically included, and they can send reports every minute if they choose. All reports in the mPING database, both past and real-time, can be viewed on the mPING web site: <http://www.nssl.noaa.gov/projects/ping/display/>

## **LANDSCAPES**

### **YardMap Network (Cornell Lab of Ornithology)**

<http://content.yardmap.org/>

This project collects data on public and private land use by asking individuals to draw maps of backyards, schoolyards, parks, farms, and gardens. The goal of the project is to cultivate richer understanding of bird habitats for those concerned with their local environments.

see also: **USA National Phenology Network**

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## **Disciplinary Core Ideas (DCIs) supported by citizen science**

**Next Generation Science Standards** (<http://www.nextgenscience.org/next-generation-science-standards>)

### **Elementary**

*Life Science*

#### **LS4.D: Biodiversity and Humans**

There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)

#### **LS2.A: Interdependent Relationships in Ecosystems**

The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some

organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)

**K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive.

**1-LS3-1.** Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like their parents.

**2-LS4-1.** Make observations of plants and animals to compare the diversity of life in different habitats

**3-LS2.** Cause and effect relationships are routinely identified and used to explain change. Groups may serve different functions and vary dramatically in size.

**5-LS2-1.** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

**5-ESS3-1.** Humans activities affect the surrounding environment. Individuals are doing things to help protect Earth’s resources and environments. Encourage people to look at media, books, and good resources to evaluate and communicate information.

## **Middle School**

### *Life Science*

#### **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
- Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health. (MS-LS2-5)

#### **LS4.D: Biodiversity and Humans**

Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

**MS-LS2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

### *Earth Science*

#### **ESS3.C: Human Impacts on Earth Systems**

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MSESS3-3),(MS-ESS3-4)

### **ESS3.D: Global Climate Change**

Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

### **High School**

#### *Life Science*

### **LS2.A: Interdependent Relationships in Ecosystems**

Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem

**HS-LS2-6.** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

**HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.\* [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

**HS-LS2-8.** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

**HS-LS4-5.** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

**HS-LS4-6.** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.